



Full wwPDB X-ray Structure Validation Report ⓘ

Mar 6, 2026 – 08:39 PM UTC

PDB ID : 4W5R / pdb_00004w5r
Title : The Crystal Structure of Human Argonaute2 Bound to a Guide and Target RNA Containing Seed Pairing from 2-8 (Long Target)
Authors : Schirle, N.T.; MacRae, I.J.
Deposited on : 2014-08-18
Resolution : 2.50 Å(reported)

This is a Full wwPDB X-ray Structure Validation Report for a publicly released PDB entry.

We welcome your comments at validation@mail.wwpdb.org

A user guide is available at

<https://www.wwpdb.org/validation/2017/XrayValidationReportHelp>

with specific help available everywhere you see the ⓘ symbol.

The types of validation reports are described at

<http://www.wwpdb.org/validation/2017/FAQs#types>.

The following versions of software and data (see [references ⓘ](#)) were used in the production of this report:

MolProbity : 4-5-2 with Phenix2.0
Mogul : 2022.3.0, CSD as543be (2022)
Xtriage (Phenix) : 2.0
EDS : 3.0
Percentile statistics : 20250101.v01 (using entries in the PDB archive January 1st 2025)
CCP4 : 9.0.010 (Gargrove)
Density-Fitness : 1.0.12
Ideal geometry (proteins) : Engh & Huber (2001)
Ideal geometry (DNA, RNA) : Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP) : 2.49

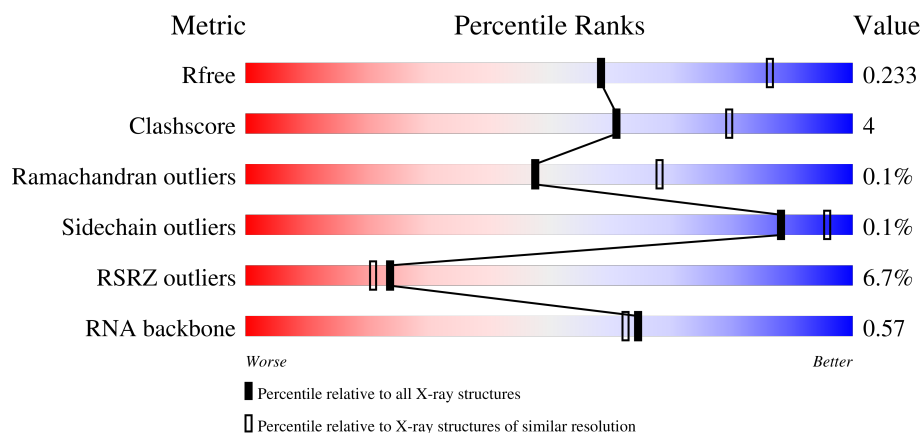
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 2.50 Å.

Percentile scores (ranging between 0-100) for global validation metrics of the entry are shown in the following graphic. The table shows the number of entries on which the scores are based.



Metric	Whole archive (#Entries)	Similar resolution (#Entries, resolution range(Å))
R_{free}	180053	5829 (2.50-2.50)
Clashscore	190562	6492 (2.50-2.50)
Ramachandran outliers	187476	6378 (2.50-2.50)
Sidechain outliers	187428	6380 (2.50-2.50)
RSRZ outliers	180081	5833 (2.50-2.50)
RNA backbone	3983	1003 (2.78-2.22)

The table below summarises the geometric issues observed across the polymeric chains and their fit to the electron density. The red, orange, yellow and green segments of the lower bar indicate the fraction of residues that contain outliers for ≥ 3 , 2, 1 and 0 types of geometric quality criteria respectively. A grey segment represents the fraction of residues that are not modelled. The numeric value for each fraction is indicated below the corresponding segment, with a dot representing fractions $\leq 5\%$. The upper red bar (where present) indicates the fraction of residues that have poor fit to the electron density. The numeric value is given above the bar.

Mol	Chain	Length	Quality of chain
1	A	859	6% 83% 10% 7%
2	B	21	10% 24% 29% 48%
3	D	13	54% 15% 31%

2 Entry composition

There are 7 unique types of molecules in this entry. The entry contains 7005 atoms, of which 0 are hydrogens and 0 are deuteriums.

In the tables below, the ZeroOcc column contains the number of atoms modelled with zero occupancy, the AltConf column contains the number of residues with at least one atom in alternate conformation and the Trace column contains the number of residues modelled with at most 2 atoms.

- Molecule 1 is a protein called Protein argonaute-2.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	803	Total	C	N	O	S	0	0	0
			6442	4103	1159	1140	40			

There is a discrepancy between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	387	ASP	SER	engineered mutation	UNP Q9UKV8

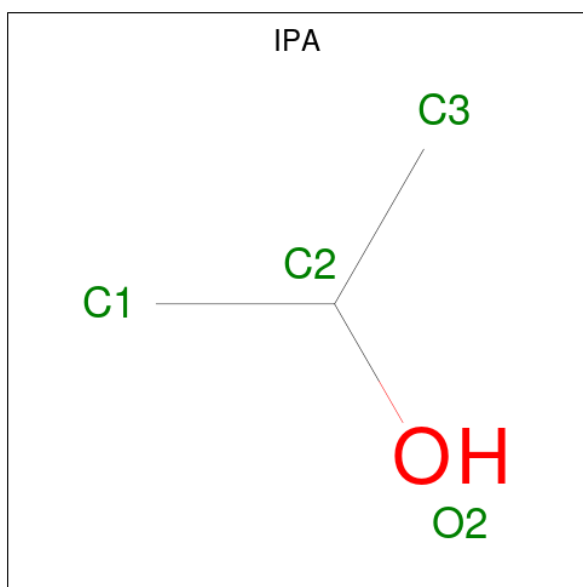
- Molecule 2 is a RNA chain called RNA (5'-R(P*UP*UP*CP*AP*CP*AP*UP*UP*GP*UP*U)-3').

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
2	B	11	Total	C	N	O	P	0	0	0
			228	102	33	82	11			

- Molecule 3 is a RNA chain called RNA (5'-R(P*AP*AP*UP*GP*UP*GP*AP*AP*A)-3').

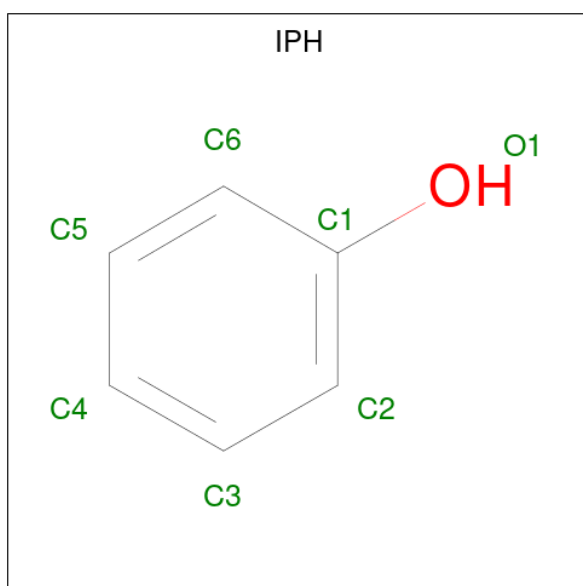
Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
3	D	9	Total	C	N	O	P	0	0	0
			178	78	34	57	9			

- Molecule 4 is ISOPROPYL ALCOHOL (CCD ID: IPA) (formula: C₃H₈O).



Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
4	A	1	Total	C	O	0	0
			4	3	1		
4	A	1	Total	C	O	0	0
			4	3	1		

- Molecule 5 is PHENOL (CCD ID: IPH) (formula: C_6H_6O).



Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
5	A	1	Total	C	O	0	0
			7	6	1		
5	A	1	Total	C	O	0	0
			7	6	1		

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Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
5	A	1	Total	C	O	0	0
			7	6	1		

- Molecule 6 is MAGNESIUM ION (CCD ID: MG) (formula: Mg).

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
6	A	1	Total	Mg	0	0
			1	1		
6	D	1	Total	Mg	0	0
			1	1		

- Molecule 7 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
7	A	115	Total	O	0	0
			115	115		
7	B	7	Total	O	0	0
			7	7		
7	D	4	Total	O	0	0
			4	4		

4 Data and refinement statistics

Property	Value	Source
Space group	P 1 21 1	Depositor
Cell constants a, b, c, α , β , γ	55.38Å 116.18Å 69.68Å 90.00° 92.17° 90.00°	Depositor
Resolution (Å)	69.63 – 2.50 69.63 – 2.50	Depositor EDS
% Data completeness (in resolution range)	99.7 (69.63-2.50) 99.7 (69.63-2.50)	Depositor EDS
R_{merge}	0.14	Depositor
R_{sym}	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ ¹	2.03 (at 2.51Å)	Xtriage
Refinement program	PHENIX (phenix.refine: 1.8.2_1309)	Depositor
R, R_{free}	0.195 , 0.234 0.197 , 0.233	Depositor DCC
R_{free} test set	1486 reflections (1.26%)	wwPDB-VP
Wilson B-factor (Å ²)	38.1	Xtriage
Anisotropy	0.573	Xtriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.35 , 44.6	EDS
L-test for twinning ²	$\langle L \rangle = 0.48$, $\langle L^2 \rangle = 0.31$	Xtriage
Estimated twinning fraction	0.040 for h,-k,-l	Xtriage
F_o, F_c correlation	0.93	EDS
Total number of atoms	7005	wwPDB-VP
Average B, all atoms (Å ²)	51.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 4.98% of the height of the origin peak. No significant pseudotranslation is detected.*

¹Intensities estimated from amplitudes.

²Theoretical values of $\langle |L| \rangle$, $\langle L^2 \rangle$ for acentric reflections are 0.5, 0.333 respectively for untwinned datasets, and 0.375, 0.2 for perfectly twinned datasets.

5 Model quality

5.1 Standard geometry

Bond lengths and bond angles in the following residue types are not validated in this section: IPH, IPA, MG

The Z score for a bond length (or angle) is the number of standard deviations the observed value is removed from the expected value. A bond length (or angle) with $|Z| > 5$ is considered an outlier worth inspection. RMSZ is the root-mean-square of all Z scores of the bond lengths (or angles).

Mol	Chain	Bond lengths		Bond angles	
		RMSZ	$\# Z > 5$	RMSZ	$\# Z > 5$
1	A	0.31	0/6593	0.73	0/8920
2	B	0.12	0/251	0.34	0/383
3	D	0.12	0/199	0.23	0/309
All	All	0.30	0/7043	0.70	0/9612

There are no bond length outliers.

There are no bond angle outliers.

There are no chirality outliers.

There are no planarity outliers.

5.2 Too-close contacts

In the following table, the Non-H and H(model) columns list the number of non-hydrogen atoms and hydrogen atoms in the chain respectively. The H(added) column lists the number of hydrogen atoms added and optimized by MolProbity. The Clashes column lists the number of clashes within the asymmetric unit, whereas Symm-Clashes lists symmetry-related clashes.

Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
1	A	6442	0	6512	54	0
2	B	228	0	117	3	0
3	D	178	0	86	1	0
4	A	8	0	16	0	0
5	A	21	0	18	0	0
6	A	1	0	0	0	0
6	D	1	0	0	0	0
7	A	115	0	0	3	0
7	B	7	0	0	0	0
7	D	4	0	0	0	0
All	All	7005	0	6749	57	0

The all-atom clashscore is defined as the number of clashes found per 1000 atoms (including hydrogen atoms). The all-atom clashscore for this structure is 4.

All (57) close contacts within the same asymmetric unit are listed below, sorted by their clash magnitude.

Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:608:LYS:HG2	1:A:821:GLU:HG2	1.74	0.69
1:A:264:GLY:O	1:A:280:ARG:NH1	2.27	0.68
1:A:151:LEU:HD12	1:A:152:PRO:HD2	1.79	0.65
1:A:167:ARG:HG2	1:A:181:PHE:HZ	1.64	0.63
1:A:293:THR:HG22	1:A:307:THR:HG22	1.81	0.62
1:A:143:LEU:HB2	1:A:158:THR:HG21	1.83	0.60
1:A:821:GLU:OE1	1:A:821:GLU:N	2.33	0.60
1:A:680:LEU:HD22	1:A:768:LEU:HB3	1.84	0.59
1:A:322:TYR:N	1:A:342:GLU:OE2	2.35	0.58
1:A:332:GLN:NE2	1:A:334:GLN:OE1	2.38	0.57
1:A:618:MET:HE3	1:A:626:CYS:HB2	1.86	0.56
1:A:48:ASP:HB2	1:A:400:MET:HB2	1.86	0.56
1:A:606:GLY:O	1:A:608:LYS:N	2.36	0.55
1:A:246:GLN:HG2	1:A:250:LEU:HD23	1.88	0.55
1:A:551:ASN:ND2	2:B:2:U:OP2	2.35	0.55
1:A:521:ILE:HD12	1:A:552:VAL:HG21	1.89	0.54
1:A:633:GLN:H	1:A:633:GLN:CD	2.14	0.54
1:A:448:ILE:HD12	1:A:485:ILE:HG12	1.90	0.53
1:A:119:LEU:HD12	1:A:120:PRO:HD2	1.92	0.51
1:A:293:THR:HA	1:A:307:THR:HA	1.91	0.50
1:A:389:ASN:O	1:A:395:ARG:NH1	2.39	0.50
1:A:535:VAL:HA	1:A:539:VAL:HB	1.94	0.50
1:A:252:ASP:OD2	7:A:1001:HOH:O	2.19	0.49
1:A:106:LEU:O	1:A:108:ILE:N	2.44	0.49
1:A:163:ASP:O	1:A:167:ARG:HB2	2.12	0.49
1:A:475:ARG:HG2	1:A:485:ILE:HB	1.95	0.49
1:A:321:ARG:HD3	1:A:322:TYR:CZ	2.49	0.48
1:A:566:LYS:NZ	1:A:859:ALA:OXT	2.42	0.48
1:A:709:LYS:NZ	7:A:1105:HOH:O	2.44	0.48
1:A:45:PHE:CZ	1:A:383:MET:HG3	2.49	0.47
1:A:437:MET:HG3	1:A:794:THR:HG21	1.97	0.46
1:A:210:LEU:HD23	1:A:743:PRO:HA	1.96	0.46
1:A:459:GLN:NE2	1:A:464:GLU:OE2	2.49	0.46
1:A:756:ILE:HD11	1:A:795:ARG:HH22	1.81	0.46
1:A:56:HIS:NE2	1:A:99:ASN:OD1	2.50	0.45
1:A:42:ALA:C	1:A:44:PHE:H	2.25	0.45
1:A:361:THR:O	1:A:365:ILE:HG12	2.16	0.45

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:491:PHE:CD1	1:A:508:LEU:HD21	2.52	0.44
1:A:332:GLN:HG3	1:A:334:GLN:H	1.82	0.44
1:A:838:ASP:N	1:A:838:ASP:OD1	2.50	0.44
1:A:55:TYR:CZ	1:A:105:PRO:HG3	2.53	0.44
1:A:391:ASP:HB3	1:A:394:VAL:HB	1.99	0.43
1:A:428:ALA:HB2	1:A:440:LYS:HE2	1.99	0.43
1:A:63:PRO:HD2	1:A:128:PHE:CD1	2.54	0.43
1:A:742:HIS:CG	1:A:743:PRO:HD2	2.53	0.42
2:B:7:U:H2'	2:B:8:U:C6	2.55	0.42
2:B:3:C:H2'	2:B:4:A:C8	2.55	0.41
1:A:277:ARG:HD3	1:A:279:TYR:OH	2.20	0.41
1:A:820:LYS:O	1:A:842:LEU:HD21	2.19	0.41
1:A:419:LEU:HD23	1:A:577:ILE:HD11	2.03	0.41
1:A:287:ARG:NH2	1:A:293:THR:H	2.19	0.41
1:A:60:ASP:HB2	1:A:131:SER:OG	2.21	0.41
1:A:225:TYR:CE2	1:A:352:CYS:HA	2.56	0.41
3:D:4:A:H2'	3:D:5:A:C8	2.55	0.40
1:A:817:LEU:HD22	1:A:842:LEU:HD22	2.03	0.40
1:A:62:LYS:HA	1:A:63:PRO:C	2.47	0.40
1:A:216:ASN:ND2	7:A:1028:HOH:O	2.54	0.40

There are no symmetry-related clashes.

5.3 Torsion angles ⓘ

5.3.1 Protein backbone ⓘ

In the following table, the Percentiles column shows the percent Ramachandran outliers of the chain as a percentile score with respect to all X-ray entries followed by that with respect to entries of similar resolution.

The Analysed column shows the number of residues for which the backbone conformation was analysed, and the total number of residues.

Mol	Chain	Analysed	Favoured	Allowed	Outliers	Percentiles
1	A	791/859 (92%)	769 (97%)	21 (3%)	1 (0%)	48 68

All (1) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	A	250	LEU

5.3.2 Protein sidechains [i](#)

In the following table, the Percentiles column shows the percent sidechain outliers of the chain as a percentile score with respect to all X-ray entries followed by that with respect to entries of similar resolution.

The Analysed column shows the number of residues for which the sidechain conformation was analysed, and the total number of residues.

Mol	Chain	Analysed	Rotameric	Outliers	Percentiles	
1	A	711/752 (94%)	710 (100%)	1 (0%)	88	96

All (1) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	479	ARG

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (9) such sidechains are listed below:

Mol	Chain	Res	Type
1	A	190	ASN
1	A	216	ASN
1	A	461	GLN
1	A	488	GLN
1	A	548	GLN
1	A	623	ASN
1	A	652	GLN
1	A	708	GLN
1	A	850	GLN

5.3.3 RNA [i](#)

Mol	Chain	Analysed	Backbone Outliers	Pucker Outliers
2	B	9/21 (42%)	1 (11%)	0
3	D	7/13 (53%)	0	0
All	All	16/34 (47%)	1 (6%)	0

All (1) RNA backbone outliers are listed below:

Mol	Chain	Res	Type
2	B	9	G

There are no RNA pucker outliers to report.

5.4 Non-standard residues in protein, DNA, RNA chains [i](#)

There are no non-standard protein/DNA/RNA residues in this entry.

5.5 Carbohydrates [i](#)

There are no oligosaccharides in this entry.

5.6 Ligand geometry [i](#)

Of 7 ligands modelled in this entry, 2 are monoatomic - leaving 5 for Mogul analysis.

In the following table, the Counts columns list the number of bonds (or angles) for which Mogul statistics could be retrieved, the number of bonds (or angles) that are observed in the model and the number of bonds (or angles) that are defined in the Chemical Component Dictionary. The Link column lists molecule types, if any, to which the group is linked. The Z score for a bond length (or angle) is the number of standard deviations the observed value is removed from the expected value. A bond length (or angle) with $|Z| > 2$ is considered an outlier worth inspection. RMSZ is the root-mean-square of all Z scores of the bond lengths (or angles).

Mol	Type	Chain	Res	Link	Bond lengths			Bond angles		
					Counts	RMSZ	$\# Z > 2$	Counts	RMSZ	$\# Z > 2$
4	IPA	A	902	-	3,3,3	0.53	0	3,3,3	0.31	0
5	IPH	A	903	-	7,7,7	0.45	0	8,8,8	0.28	0
4	IPA	A	901	-	3,3,3	0.53	0	3,3,3	0.28	0
5	IPH	A	905	-	7,7,7	0.41	0	8,8,8	0.31	0
5	IPH	A	904	-	7,7,7	0.42	0	8,8,8	0.29	0

In the following table, the Chirals column lists the number of chiral outliers, the number of chiral centers analysed, the number of these observed in the model and the number defined in the Chemical Component Dictionary. Similar counts are reported in the Torsion and Rings columns. '-' means no outliers of that kind were identified.

Mol	Type	Chain	Res	Link	Chirals	Torsions	Rings
5	IPH	A	904	-	-	-	0/1/1/1
5	IPH	A	905	-	-	-	0/1/1/1
5	IPH	A	903	-	-	-	0/1/1/1

There are no bond length outliers.

There are no bond angle outliers.

There are no chirality outliers.

There are no torsion outliers.

There are no ring outliers.

No monomer is involved in short contacts.

5.7 Other polymers

There are no such residues in this entry.

5.8 Polymer linkage issues

There are no chain breaks in this entry.

6 Fit of model and data

6.1 Protein, DNA and RNA chains

In the following table, the column labelled ‘#RSRZ > 2’ contains the number (and percentage) of RSRZ outliers, followed by percent RSRZ outliers for the chain as percentile scores relative to all X-ray entries and entries of similar resolution. The OWAB column contains the minimum, median, 95th percentile and maximum values of the occupancy-weighted average B-factor per residue. The column labelled ‘Q < 0.9’ lists the number of (and percentage) of residues with an average occupancy less than 0.9.

Mol	Chain	Analysed	<RSRZ>	#RSRZ>2	OWAB(Å ²)	Q<0.9
1	A	803/859 (93%)	0.31	53 (6%) 24 21	27, 46, 88, 114	0
2	B	11/21 (52%)	0.20	2 (18%) 3 2	32, 35, 94, 112	0
3	D	9/13 (69%)	-0.02	0 100 100	50, 53, 82, 83	0
All	All	823/893 (92%)	0.30	55 (6%) 24 21	27, 46, 88, 114	0

All (55) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	A	86	ILE	4.3
1	A	127	ILE	4.2
1	A	22	ALA	4.0
1	A	304	VAL	4.0
1	A	23	PHE	3.9
1	A	85	GLN	3.7
1	A	120	PRO	3.7
1	A	603	ALA	3.6
1	A	117	VAL	3.5
1	A	296	LEU	3.5
1	A	269	ILE	3.5
2	B	9	G	3.4
1	A	156	PHE	3.3
1	A	319	VAL	3.0
1	A	836	GLY	3.0
1	A	114	GLU	2.9
1	A	113	VAL	2.8
1	A	81	HIS	2.8
1	A	116	GLU	2.7
1	A	87	PHE	2.7
1	A	119	LEU	2.7
1	A	118	THR	2.7
1	A	294	PHE	2.6

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Mol	Chain	Res	Type	RSRZ
1	A	837	ARG	2.5
1	A	211	TRP	2.5
1	A	63	PRO	2.5
1	A	115	LEU	2.5
1	A	332	GLN	2.5
1	A	82	PHE	2.5
1	A	109	GLY	2.5
1	A	321	ARG	2.4
1	A	370	ARG	2.4
1	A	607	LYS	2.4
1	A	239	ASP	2.3
1	A	318	LEU	2.3
1	A	130	VAL	2.3
1	A	90	ARG	2.3
1	A	322	TYR	2.3
1	A	276	LYS	2.2
1	A	309	ALA	2.2
1	A	100	LEU	2.2
1	A	51	LYS	2.2
1	A	83	LYS	2.2
2	B	8	U	2.2
1	A	59	LEU	2.2
1	A	172	MET	2.1
1	A	151	LEU	2.1
1	A	104	MET	2.1
1	A	112	LYS	2.1
1	A	108	ILE	2.1
1	A	478	SER	2.1
1	A	128	PHE	2.0
1	A	423	ARG	2.0
1	A	106	LEU	2.0
1	A	641	ASP	2.0

6.2 Non-standard residues in protein, DNA, RNA chains [i](#)

There are no non-standard protein/DNA/RNA residues in this entry.

6.3 Carbohydrates [i](#)

There are no oligosaccharides in this entry.

6.4 Ligands [i](#)

In the following table, the Atoms column lists the number of modelled atoms in the group and the number defined in the chemical component dictionary. The B-factors column lists the minimum, median, 95th percentile and maximum values of B factors of atoms in the group. The column labelled 'Q< 0.9' lists the number of atoms with occupancy less than 0.9.

Mol	Type	Chain	Res	Atoms	RSCC	RSR	B-factors(Å ²)	Q<0.9
4	IPA	A	901	4/4	0.75	0.21	39,44,51,59	0
4	IPA	A	902	4/4	0.81	0.16	46,48,49,51	0
5	IPH	A	904	7/7	0.88	0.13	35,38,40,41	0
5	IPH	A	905	7/7	0.88	0.19	40,43,46,48	0
6	MG	D	101	1/1	0.89	0.07	47,47,47,47	0
5	IPH	A	903	7/7	0.92	0.13	36,39,45,55	0
6	MG	A	906	1/1	0.98	0.06	41,41,41,41	0

6.5 Other polymers [i](#)

There are no such residues in this entry.